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Construction Engineering  
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**US Army Corps  
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Engineer Research and  
Development Center

# **Engineered Management Systems in War**

## **An In-Theater Application of BUILDER™**

Samuel L. Hunter and R. Mark Harry

October 2005

# Engineered Management Systems in War

## An In-Theater Application of BUILDER™

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### Final Report

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Under             Mission-Focused Infrastructure Investment

**ABSTRACT:** Rapid infrastructure assessment is crucial as U.S. military services perform combat and security missions in contingency operations. Engineer personnel need the capability to assess and manage in-theater infrastructure to notify newly arriving units about supply requirements, locations for camps or billeting, and the service capacities of area utilities. This report documents how Army engineers used the BUILDER™ engineered management system to rapidly assess the suitability of housing facilities in Kuwait for troop occupancy and expedite the deployment of labor and other resources for necessary maintenance and repair.

The use of BUILDER™ to manage the inventory, inspection, condition assessment, and project formulation tasks in this demonstration provided significant benefits. It minimized the amount of time inspectors had to work away from base camp and enabled the team to quickly develop an accurate building assessment, condition index, and scope of work for rehabilitation purposes. BUILDER™ also helped the team to rapidly develop an accurate bill of materials, plan optimal deployment of available manpower, and communicate essential information to all involved levels of command.

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## Conversion Factors

Non-SI\* units of measure used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
cubic inches	0.00001638706	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	$(5/9) \times (^\circ\text{F} - 32)$	degrees Celsius
feet	0.3048	meters
gallons (U.S. liquid)	0.003785412	cubic meters
inches	0.0254	meters
miles (U.S. statute)	1.609347	kilometers
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
square feet	0.09290304	square meters
square miles	2,589,998	square meters
tons (force)	8,896.443	newtons
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

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\* *Système International d'Unités* (International System of Measurement), commonly called the metric system.

## Preface

This special report was prepared for Headquarters, U.S. Army Corps of Engineers, in support of the ERDC-CERL Mission-Focused Infrastructure Investment program under U.S. Army Research, Development, Test, and Evaluation Project 4A162784AT41, “Military Facilities Engineering Technology.” The technical reviewer was Larry Allen, MANSCEN\* Liaison Officer, CEERD-GV-T.

The work documented in this report was performed by Engineers of the 416<sup>th</sup> Engineer Command (ENCOM), Darien, IL, and the 111th Engineer Group, West Virginia Army National Guard, St. Albans, WV. It supports research currently being performed by the Facilities Maintenance Branch (CF-F) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The principal author, Samuel L. Hunter, participated in this work while deployed as a Captain in the 416<sup>th</sup> ENCOM in support of Operation Enduring Freedom and Operation Iraqi Freedom. Donald K. Hicks is Acting Chief, CEERD-CF-F, and L. Michael Golish is Chief, CEERD-CF. The Technical Director of the Facility Acquisition and Revitalization business area is Dr. Paul A. Howdyshell, CEERD-CV-ZT, and the Acting Director of CERL is Dr. Ilker R. Adiguzel.

The Commander of the 416<sup>th</sup> ENCOM is MG Robert Heine, EN.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of the ERDC is COL James R. Rowan, and the Director is Dr. James R. Houston.

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\* MANSCEN: U.S. Army Maneuver Support Center.

# 1 Introduction

## Background

Rapid infrastructure assessment is an important requirement as U.S. military services perform combat and security missions in contingency operations. To best sustain dynamic military operations, personnel in the field would be greatly assisted by having access to engineering guidance or tools that help to provide rapid, reliable information on the infrastructure and utilities for which the military unit is responsible. Accurate information about utility systems (e.g., electric, water, sewage) as well as buildings, structures, and pavements can be essential to the success of a mission, especially in a post-combat environment where troops are responsible for providing ongoing security. Engineer personnel need the capability to assess and manage in-theater infrastructure to notify newly arriving units about supply requirements, locations for camps or billeting, and the service capacities of area utilities.

In analyses of military operations in Afghanistan and Iraq, a recurring theme is the need for assessment tools applicable to each infrastructure engineering area of concern, both to provide in-theater solutions and to perform data collection for reach-back support. During recent operations, for example, ground troops in many cases did not know what to look for to determine a structure's condition or what information to collect for the engineers. In cases where incorrect or incomplete data were collected, engineers did not have sufficient information to properly assess the infrastructure in the area of interest.

To address this problem, engineers of the 416<sup>th</sup> Engineer Command (ENCOM), Darien, IL, demonstrated that an existing engineered management system, developed to support military installation personnel responsible for infrastructure maintenance and repair programs, could be used to support essential activities of the theater engineer and planner.



## Objective

The objective of this report is to document how Army theater engineers used the BUILDER™ engineered management system to (1) rapidly assess the suitability of housing facilities in Kuwait for occupancy by U.S. troops and (2) expedite the deployment of labor and other resources to ensure that necessary repairs would be made with minimal lead time in order to prepare for the arriving troops.

## Approach

In general, personnel of the 416<sup>th</sup> ENCOM applied the BUILDER™ Engineered Management System version 2.1 according to the field inspection manual\* to rapidly assess building condition and determine repair needs to meet a large military housing requirement in a very short time. Because BUILDER's remote data entry and automated support features were not accessible from the field, engineers applied the EMS manually using handwritten forms.

## Scope

The results documented in this report pertain only to BUILDER™ 2.1 and later. All Corps-developed EMSs share significant core engineering principles and technical points of reference, but the applicability of other EMSs to in-theater infrastructure management is not necessarily implied by this report's conclusions. The applicability of any other EMS in contingency operations would have to be validated with an appropriate demonstration of that specific EMS.

## Mode of Technology Transfer

For more information about BUILDER, please contact:

Michael N. Grussing, Civil Engineer, ERDC-CERL, P.O. Box 9005, Champaign, IL 61826-9005; 217-398-5307 (voice); 217-373-3490 (fax), or email to [Michael.N.Grussing@erdc.army.mil](mailto:Michael.N.Grussing@erdc.army.mil).

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\* The current version of this document is Uzarski, D.R., *BUILDER™ Knowledge-Based Condition Assessment Manual for Building Component Sections*, online file included with BUILDER™ 2.2 and BUILDER™ RED™ 2.2 (ERDC-CERL, October 2003). It is cited in this report as "Uzarski 2003."

Lance R. Marrano, Project Manager, ERDC-CERL, P.O. Box 9005, Champaign, IL 61826-9005; 217-373-4465 (voice); 217-373-3490 (fax), or email to [Lance.R.Marrano@erdc.army.mil](mailto:Lance.R.Marrano@erdc.army.mil).

BUILDER™ and BUILDER™ training are available to all military and civilian users through the BUILDER™ EMS Support Center administered through the University of Illinois at Urbana-Champaign. For information contact Scott McDonald, 217-373-4536, or [techctr@uiuc.edu](mailto:techctr@uiuc.edu).

The official ERDC-CERL fact sheet on the BUILDER™ EMS is reproduced in Appendix A.

## 2 An Application of BUILDER™ in the Iraq Theater

### The Role of Infrastructure Assessment in a Theater of Operations

Infrastructure assessment is an important part of the planning process for Army contingency operations. To know how well in-theater infrastructure will support an operation or mission, military planners need reliable information on its current condition and its capacity to provide the intended service. In order to plan for mobile operations, for example, planners must know the existing condition and capacity of proposed main supply routes (MSRs) and alternate supply routes (ASRs). For successful planning of longer-term security or sustainment operations, planners need accurate information on the condition of area buildings, potable water distribution networks, sewage systems, and the electrical power grid.

No management support tool has been developed specifically for preparing objective, engineering-based infrastructure assessments within a military theater of combat operations. Consequently, engineers in-theater must rely largely on subjective experience to plan for an operation. This subjectivity can produce differing individual interpretations of sketchy information, which can in turn cause confusion for recipients of the information up the chain of command. One possible way to address this problem is to employ engineering-based tools with applicable capabilities that were designed to support the management of conventional military or municipal infrastructure. One such category of tools is collectively known as engineered management systems, first developed more than 30 years ago to help the Army track the condition of large inventories of constructed facilities and systematically plan for their maintenance and repair.

### Overview of Engineered Management Systems (EMSs)

An EMS is a set of engineering-based inspection, data collection, condition assessment, and maintenance planning protocols developed to help military installation managers identify and prioritize infrastructure maintenance and repair (M&R) needs. The Construction Engineering Research Laboratory (CERL), now

an element of the U.S. Army Engineer Research and Development Center (ERDC), developed the first EMS in the early 1970s. That EMS for management of concrete and asphalt pavements, called PAVER, has been improved and refined many times over the years, including the implementation of computer automation for analytical tasks. Although developed for military installation roadways and airfield pavements, PAVER has been adopted by many non-military institutions and municipalities. ERDC-CERL subsequently developed other EMSs, including RAILER™, ROOFER™, and BUILDER™.

An EMS assists engineering and facilities personnel in the collection of objective, standardized asset condition information to help ensure that M&R is provided at the most advantageous time in terms of facility life cycle and resource availability. This M&R decision support helps to avoid the excessive rehabilitation costs that result from neglect as well as the excessive expenditures sometimes incurred by providing lower-priority maintenance before it is justified. EMSs provide inspection, data management, and decision support for the following tasks:

- inventory
- inspection
- condition assessment
- condition prediction
- condition analysis
- M&R planning
- budget consequence analysis
- project formulation
- project prioritization
- GIS presentation.

The BUILDER™ EMS combines engineering, architectural, and management expert knowledge with database management technology to help users plan the optimal level of building M&R at the lowest cost. BUILDER™ includes methods for gathering, storing, processing, retrieving, and reporting building inspection and assessment data.

A significant portion of EMS life-cycle cost benefits are made possible through the timely scheduling of preventive maintenance. In a military contingency operation, however, infrastructure M&R requirements are not based on preventive maintenance concerns. Therefore, engineers have not considered systems such as BUILDER™ applicable to infrastructure management in that environment.

## **BUILDER™ Demonstration**

In April 2003, some frontline troops deployed in Operation: Iraqi Freedom were ordered to report to Camp Arifjan, Kuwait. That installation was to be used as a pseudo Reception, Staging, Onward Movement, and Integration base to pre-

pare those troops for movement back to the United States. The 226th Area Support Group (ASG), Mobile, AL (Alabama Army National Guard) was tasked to find housing for these troops. It was quickly found out that there were no more Force Provider kits or other type of tents available to house the number of troops expected. Camp Arifijan is located within the installation boundaries of a base that belongs to the Kuwaiti 15th Mubarak Infantry Brigade. The 226th ASG queried the 15th Mubarak Brigade about the availability of any unused barracks that could be requisitioned to temporarily house U.S. troops, and some were identified for that purpose. A week later, the 226th ASG was informed that more troops would have to be accommodated than originally planned, and subsequently the Kuwaiti Army provided additional facilities located on a Kuwaiti Army National Guard Base within the installation boundaries. The 226th ASG had to determine if the facilities were suitable to house American soldiers and, if not, what level of effort would be needed to raise them to standard. Because the 226th ASG has a very small engineering cell that lacks experience in building condition assessment, they requested assistance from theater engineers of the 416th ENCOM. Twenty-five Kuwaiti facilities, encompassing approximately 60,000 sq ft, had to be inspected and assessed.

On the Kuwaiti Army installation, portions of seven barracks totaling 4,000 sq ft were made available. The buildings are of masonry construction designed as shown in Figure 1.



**Figure 1. Two Kuwaiti Army barracks provided for temporary U.S. Army use.**

On the Kuwaiti Army National Guard base, the following facilities were made available:

- 1 restroom/latrine building (2,500 sq ft)
- 1 dining facility (3,000 sq ft)

- 1 administrative building (3,000 sq ft)
- 15 barracks buildings (1,600 sq ft each; 24,000 sq ft total)

Figure 2 shows portions of the barracks and administrative facility.



**Figure 2. Kuwaiti Army National Guard barracks (left) and administrative facility interior.**

The 416th engineers considered whether using BUILDER™ could help execute their assignment more efficiently than an ad hoc project management approach. They agreed that the EMS is based on valid engineering fundamentals applicable to the task. The team identified four BUILDER™ capabilities that could directly facilitate rapid, effective accomplishment of the work. These were the Inventory, Inspection, Condition Assessment, and Project Formulation modules.

The engineers followed the procedures outlined in the BUILDER™ online field inspection manual (Uzarski 2003), starting with the collection of inventory data. Because no facility drawings were available to use as the basis for an inventory, the project team had to conduct the inventory by walkthrough. As a result, it was most efficient to also perform the condition inspections at the time of the walkthrough. The BUILDER™ method of dividing a facility into systems and components made these tasks easier by providing focus and systematic procedures for documentation.

The engineer team collected all inventory and inspection data manually, using pen and paper. The full EMS includes an ‘electronic clipboard’ capability called BUILDER™ RED™ (Remote Entry Database). That capability, also called BRED, is a pen-operated application for tablet computer used to collect inventory and inspection data. BRED significantly reduces data collection costs and improves inspection efficiency, but the 416th ENCOM did not have access to the application in theater.

## Summary of Procedure

### *Inventory Data Collection*

The BUILDER™ inventory process collects data on building systems, which are categorized under one of the following 11 modules:

- conveying
- electrical
- exterior circulation
- exterior closure
- fire suppression
- heating, ventilating, and air conditioning (HVAC)
- interior construction
- plumbing
- roofing
- specialties
- structural

These modules include multiple subsystems that are categorized according to component, equipment, or material type, as detailed in the BUILDER™ field inspection manual (Uzarski 2003). The following components were in place in the facilities of interest in the Kuwait demonstration, each listed under the applicable building system addressed in BUILDER™:

#### Electrical:

- exterior lights
- interior lights
- panel boards
- lighting protection/grounding

#### Exterior Circulation:

- exterior walkways
- exterior stairs

#### Exterior Closure:

- exterior doors
- exterior windows
- exterior walls

#### Fire Protection:

- standpipes
- fire/smoke alarms

**HVAC:**

- window/wall air conditioners
- ventilation
- cooling towers

**Interior Construction:**

- interior floor finish
- interior wall finish
- interior ceilings
- interior floors
- interior walls

**Plumbing:**

- plumbing fixtures
- water supply
- waste piping
- water storage tanks

**Roofing:**

- roof membrane
- roof flashing
- roof drainage

**Structural:**

- columns

***Inspection Process***

The inspection was a purely visual process. Project team members walked through the facilities and determined that all were in approximately the same condition. This general uniformity of condition justified the use of the sampling techniques explained in the BUILDER™ inspection manual (Uzarski 2003), eliminating the need for a detailed, redundant inspection of each facility and therefore dramatically increasing inspection efficiency.

The goal of the inspection process is to record system and component distresses according to the definitions incorporated into BUILDER. Distresses are recorded in terms of type, amount, and severity. In cases where sampling is justified by an overall uniformity of facility condition, as it was in the Kuwait demonstration, inspection time can be drastically reduced as compared with the time



needed for a full inspection of every building. Figure 3 – Figure 7 show portions of the BUILDER™ inspection process carried out at both locations in theater.



**Figure 3. Engineer team members inspect exterior of Kuwaiti Army National Guard barracks.**



**Figure 4. Engineers apply BUILDER™ EMS inspection criteria to barracks washroom.**



Figure 5. Engineer inspects Kuwaiti Army National Guard administration facility exterior.



Figure 6. Engineer team members inspect interior of a Kuwaiti Army barracks building.



Figure 7. Engineer inspects cooling tower disconnect switch on Kuwaiti Army building.

### Condition Assessment

Using the inventory and inspection data collected for the subject facilities, theater engineers calculated a general condition index following the rating scale and descriptors used in all EMSs. That condition indexing guidance, shown in Table 1, fully supports individual engineering judgment at the inspection stage but helps to provide objectivity in the actual assessment of condition. Objective condition assessment criteria promote uniformity and repeatability of results, meaning that proper use of BUILDER™ and other EMSs will produce reliable condition assessments as long as the inspection is performed by a qualified person.

Table 1. EMS condition indexing categories and criteria.

Condition Category	Condition Scale	Condition Description		
		Amount of Distress	Functionality	Type of M&R
Excellent	86 - 100	Minimal deterioration	Not impaired	Preventative or minor maintenance, or minor repair
Very Good	71 - 85	Minor deterioration	Slightly impaired	Preventative or minor maintenance, or minor repair
Good	56 - 70	Moderate deterioration	Somewhat impaired	Moderate maintenance or minor repair
Fair	41 - 55	Significant deterioration	Seriously impaired	Significant maintenance or moderate repair
Poor	26 - 40	Severe deterioration over small portion	Critically impaired	Major repair
Very Poor	11 - 25	Severe deterioration over moderate portion	Barely Exists	Major repair but less than total restoration
Failed	0 - 10	Severe deterioration over large amount	Lost	Total restoration



As indicated previously, the BUILDER™ methodology allows for inspection data to be extrapolated to non-inspected areas that generally have been judged to be in similar condition. Similarly, BUILDER™ extrapolates the condition index of inspected systems to non-inspected systems of the same type and general condition. This methodology greatly assisted in the reporting efforts of the ENCOM inspection team and thereby promoted rapid engineer support to complete the repairs in the allotted time.

The project team assessed the barracks of interest on the Kuwaiti Army base to be in Very Good condition, with a condition index of 80 (see Table 1). The administrative building and the dining facility on the Kuwaiti Army National Guard base also were assessed to be in Very Good condition, with a condition index of 75. These ratings signify that the facilities require only preventive maintenance or minor repairs to meet the applicable Army housing standards.

In contrast, the restroom facilities on the Kuwaiti Army National Guard base were found to be in Good condition, with a condition index of 60. The barracks facilities at the same site were also assessed to be in Good condition, with a condition index of 57. These condition indices indicate that moderate maintenance activities or minor repairs will be needed to bring the facilities up to U.S. Army occupancy standards. In other words, a greater level of rehabilitation effort is needed on buildings in Good condition than on facilities were determined to be in Very Good condition.

### ***Project Formulation***

When BUILDER™ is used to sample inspection data from representative facilities and extrapolate it to develop condition indices for similar non-inspected areas, the Project Formulation module can be used to help the user formulate general repair or replacement requirements. The actual methods and materials used to meet those requirements are determined by the project manager in the context of the specific asset and its condition. By supplementing their own field experience and professional judgment with Project Formulation module repair scenarios, the engineers could rapidly develop an appropriate bill of materials and manpower requirements for repairing the identified distresses.

Five projects were developed for the facilities at the Kuwaiti Army base:

- **Miscellaneous Plumbing Repairs.** This project includes but is not limited to replacing Kuwaiti water closets with American-style water closets, and replacing piping for the water storage tanks.

- **Miscellaneous Electrical Repairs.** This project includes but is not limited to the installing of missing electrical cover plates over the switches, receptacles, and junction boxes; replacing damaged panel board cover doors; and replacing light bulbs.
- **Miscellaneous Fire Protection Repairs.** This project includes but is not limited to the installation of smoke/heat detectors and placing fire extinguishers throughout the sleeping areas.
- **Miscellaneous HVAC Repairs.** This project includes but is not limited to installing window or wall air conditioning units throughout the sleeping area.
- **Miscellaneous Interior Construction Repairs.** This project includes but is not limited to replacing keyed locksets on doors, replacing two glass doors, painting, and replacing broken ceramic tiles.

Shortly after completing the site visit, the 416<sup>th</sup> ENCOM engineer team delivered an 80% bill of materials of (repair materials and replacement parts) to the G-4 (supply section). That bill of materials is shown in Appendix B. Because most of the required work amounted to routine maintenance, all supplies on the list were available on the local market. The supply section purchased the materials the same day for delivery to the site the following day. Meanwhile, members of the engineer team briefed the G-3 (operations section) on the level of effort and skills required to complete the repairs. Because engineers are in short supply and high demand in a contingency operation, it is important to assign only the minimum number of engineers with the appropriate skill sets to a given repair project. This coordination helped the operations section to optimize the work team in terms of skills and size. Work could start the next day because the necessary types and amounts of supplies had been acquired, and an appropriately sized work team with the right skill mix was assigned to the task.

Five projects also were developed for the facilities at the Kuwaiti Army National Guard base:

- **Miscellaneous Plumbing Repairs.** This project includes but is not limited to replacing Kuwait water closets with American-style water closets and replacing the showerheads in the restroom.
- **Miscellaneous Electrical Repairs.** This project includes but is not limited to replacing light bulbs, installing additional receptacles, and replacing missing switch, receptacle, and junction box cover plates.
- **Miscellaneous Fire Protection Repairs.** This project includes but is not limited to installing smoke/heat detectors and placing fire extinguishers throughout the sleeping areas.

- **Miscellaneous HVAC Repairs.** This project includes but is not limited to installing window or wall air conditioning units in the billeting buildings.
- **Miscellaneous Interior Construction Repairs.** This project includes but is not limited to replacing missing floor tiles, replacing missing acoustical ceiling tiles, installing key locksets, filling holes in the walls, painting, and replacing broken ceramic tiles in the bathroom.

Just as the engineers completed project formulation in BUILDER™, they were informed that the expected number of soldiers returning to Camp Arifijan had decreased. Therefore, it would not be necessary to use or upgrade the Kuwaiti Army National Guard facilities, so no bill of materials was needed or developed.

### 3 Summary

The use of BUILDER™ to manage the inventory, inspection, condition assessment, and project formulation tasks associated with the rapid preparation of soldier housing in Kuwait provided the following significant benefits:

- minimized the amount of time the soldiers on the inspection team had to work ‘outside the wire’ (i.e., away from base camp)
- enabled the project team to quickly develop an accurate building condition index and objective assessment that accurately characterized the level of effort and resources required for facility rehabilitation
- facilitated rapid development of an accurate scope of work, thereby dramatically reducing project formulation time as compared with manual methods
- rapidly developed a bill of materials for repair parts and supplies with better accuracy than manual methods, thereby eliminating the need for extra trips to purchase supplies
- enabled rapid calculation of how to optimize deployment of available manpower, which was especially useful in allocating the time of theater engineers, who are in high demand in contingency operations
- facilitated the communication of objective, reliable infrastructure condition information to all levels of command involved in the effort.

The 416th ENCOM engineers who participated in this demonstration agreed that BUILDER™ can effectively help them support fast-moving Army contingency operations.

## Appendix A: BUILDER™ Product Fact Sheet



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### BUILDER® Engineered Management System (EMS)

#### Technology

BUILDER Engineered Management System (EMS) is a Windows™ based software application for building infrastructure management. Because building assets are so vast and diverse, a “knowledge-based” philosophy drives the BUILDER process. The process starts with the automated download of real property data, and then more detailed system inventory is modeled and/or collected which identifies components and their key life-cycle attributes such as the age and material. From this inventory, Condition Index (CI) measures for each component are predicted based on its expected stage in the life-cycle. Objective and repeatable inspections can then be performed on various components to verify their condition with respect to the expected life-cycle deterioration. The level of detail and frequency of these inspections are not fixed like other processes; they are dependent on knowledge of component criticality, the expected and measured condition and rate of deterioration, and remaining maintenance and service life. This “Knowledge-based” inspection focuses attention to the most critical components at the time. In addition to these condition assessments, functionality assessments can be performed to evaluate user requirement changes, compliance and obsolescence issues. This provides a comprehensive picture of the overall performance of building assets and their key components.

#### Problem

The Army owns over 165,000 buildings comprising 1.1 billion square feet. It spends about 55 percent of its installation real property maintenance funds on maintenance and repair (M&R) of these buildings. But, because of tighter resources on funding and personnel, inspection and preventative maintenance programs for critical building systems and components have been abandoned at many installations. This has forced building managers into a largely reactionary mode, responding to unexpected component breakdowns and system failures at the most inopportune and expensive time. In addition, many buildings currently serve some function to the mission that is much different than the originally intended purpose when designed. The total result is that work cannot be planned, programmed, and budgeted efficiently. BUILDER EMS addresses these issues by providing managers responsible for the building assets with a support tool for sustainment, restoration, and modernization (SRM) decisions.

#### Benefits

BUILDER is an asset management solution to repeated GAO criticisms of existing DoD facility management practices. It is an important tool in ensuring mission readiness, and sustaining building infrastructure investment. With information about condition, functionality, and remaining service life, short and long-range work plans can be developed based on sound investment strategies, prioritization criteria, and budget constraints. Penalty costs are reduced allowing more work to be accomplished with the resulting improvement in mission readiness. Simulations can be run to show the future impact of current M&R decisions. The result is a flexible list of work items expected to be accomplished based on actual funding levels. In all, the BUILDER process provides a more proactive means of asset management and resource allocation. In addition, the knowledge-based principles have been proven to significantly lower the cost of re-inspections while providing more meaningful SRM decision support metrics.

#### Status

BUILDER version 2.2 was released early in 2004. A desktop program, BUILDER also includes IMPACT, a simulation engine to model the effects that funding, standards, and prioritization decisions have on facility condition. Builder 3.0 is scheduled to be completed in mid 2005, and will be re-engineered as a web application, running through a web server.



Running on both Oracle" and SQL Server", it will include support for enterprise-wide application with a robust security model and multi-level organization support.

**Distribution Source** BUILDER may be purchased from the Technical Assistance Center, Suite 202 University Centre, 302 E. John St., Champaign, IL 61820; Phone: 217-333-5414; online purchase is available through URL:

<http://www.tac.uiuc.edu/>

**Documentation** Program documentation and reference manuals can be purchased from the listed distribution source.

**Support** BUILDER training and support is available to all military and civilian users through the BUILDER EMS Support Center administered through the University of Illinois. Contact Scott McDonald at 217-373-4536 or [techctr@uiuc.edu](mailto:techctr@uiuc.edu)

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## Appendix B: Bill of Materials for In-Theater BUILDER™ Inspection Data

Item/description	Quantity	Unit
Single Pole light switch, 240/415 V, white, single gang, flush mounted	25	ea
60 W Incandescent light bulbs	50	ea
Blank plate, white, 76 mm x 76 mm, for single gang boxes	50	ea
40 w Fluorescent T8 lamps (bulbs), 1500 mm length, medium bipin (G13) base	476	ea
13 w Fluorescent T8 lamps (bulbs), 300 mm length, medium bipin (G13) base	84	ea
Receptacles (switch socket outlet), 240/415V, single gang, white	40	ea
Panel board doors, for 12 circuit panel boards, flush lock and latch for doors	28	ea
Panel board doors, for 42 circuit panel boards, flush lock and latch for doors	12	ea
Storefront glass door, 900 mm x 2000 mm, complete with hinges, keyed lockset, and panic hardware	2	ea
Smoke detector/alarm, photoelectric, with at least 85 dB horn and 9 V battery	70	ea
Fire extinguishers, tri-class "ABC" dry chemical, pro line valve, weight 10 lb	28	ea
Shower head, fixed, drenching, polished chrome	36	ea
Lavatory faucet, 100 mm mounting center, lever handle, metal	15	ea
Lavatory, wall hung, 100 mm center, enamel	1	ea
Lavatory faucet handles, metal	36	ea
Shower faucet handles, metal	8	ea
Potable water supply stops, straight stop, 12 mm FIP by 9 mm OD compression	12	ea
Flat top gate valve threaded connection, bronze, 20 mm nominal size	12	ea
Industrial Woven fire hose, 63 mm single jacket rubber lined 250 psi with brass couplings, 15 m lengths	7	ea
PVC, schedule 80, 50 mm diameter	30	m
PVC, schedule 80, 50 mm diameter, Tee	6	ea
PVC, schedule 80, 50 mm diameter, elbow	6	ea
11 kg bag, gray ceramic tile latex modified mortar	1	ea

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<b>14. ABSTRACT</b>  <p>ABSTRACT: Rapid infrastructure assessment is crucial as U.S. military services perform combat and security missions in contingency operations. Engineer personnel need the capability to assess and manage in-theater infrastructure to notify newly arriving units about supply requirements, locations for camps or billeting, and the service capacities of area utilities. This report documents how Army engineers used the BUILDER™ engineered management system to rapidly assess the suitability of housing facilities in Kuwait for troop occupancy and expedite the deployment of labor and other resources for necessary maintenance and repair.</p> <p>The use of BUILDER™ to manage the inventory, inspection, condition assessment, and project formulation tasks in this demonstration provided significant benefits. It minimized the amount of time inspectors had to work away from base camp and enabled the team to quickly develop an accurate building assessment, condition index, and scope of work for rehabilitation purposes. BUILDER™ also helped the team to rapidly develop an accurate bill of materials, plan optimal deployment of available manpower, and communicate essential information to all involved levels of command.</p>					
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